CLAIMS (as originally filed)

1. A method for cluster fragmentation comprising the steps:
   - production of at least one cluster which contains a carrier substance, and
   - fragmentation of the cluster into cluster fragments,

   characterized in that

   the cluster is loaded before the fragmentation with at least one reaction partner which is chemically different from the carrier substance and is part of at least one cluster fragment after the fragmentation.

2. The method according to claim 1, wherein the cluster is loaded with at least one reaction partner which forms a pair of electrically differently charged charge carriers spontaneously with the carrier substance in the cluster or excited from the outside, and at least one electrically charged cluster fragment is formed during the fragmentation.

3. The method according to claim 2, wherein the cluster is additionally loaded with an electrically neutral molecule.

4. The method according to claim 3, wherein, for manipulation of the neutral molecules, they are applied as an adsorbate coating to a solid body surface and are transferred from the solid body surface into a charged cluster fragment.

5. The method according to one of the preceding claims, wherein the cluster fragmentation occurs through collision of the cluster with a moving or static boundary surface or through radiation excitation.

6. The method according to claim 5, wherein the boundary surface is a gas phase/liquid or gas phase/solid body boundary surface.

7. The method according to claim 6, wherein the boundary surface is formed by a solid body surface made of a metal, a semiconductor, or a dielectric.

8. The method according to claim 6, wherein the boundary surface is coated with the reaction partner adsorbates at a surface density whose temporal average has a predetermined value.

9. The method according to one of the preceding claims, wherein the loading with the reaction partner occurs during the cluster production, during the cluster movement toward the boundary surface by interaction with at least one gas phase particle of the reaction partner, and/or during the collision with the boundary surface by absorption of reaction partner adsorbates into the cluster.

10. The method according to one of the preceding claims, wherein polar molecules or molecule groups are used as the carrier substance and atoms and/or molecules or atom or molecule groups with low ionization energy are used as the reaction partner.

11. The method according to claim 10, wherein alkali metal atoms are used as the reaction partner.

12. The method according to one of the preceding claims, wherein multiple clusters to be fragmented are produced by ultrasound expansion of a gas and/or a gas mixture by means of a nozzle arrangement.

13. The method according to claim 12, wherein the produced clusters are subjected to geometric beam limiting to irradiate the boundary surface according to a predetermined pattern.

14. The method according to one of the preceding claims, wherein the clusters are ionized before the collision and the ionized clusters, particularly their kinetic energy, are influenced by electric and/or magnetic fields.

15. The method according to claim 14, wherein the ionization of the clusters occurs according to the method according to one of the claims 1 to 13.

16. The method according to one of the preceding claims, wherein the cluster fragments are subjected to a count, a mass spectroscopy examination, or a substance analysis.

17. The method according to one of the preceding claims, wherein the fragmentation of the cluster occurs by glancing incidence of the cluster on a boundary surface.

18. The method according to one of the preceding claims, wherein the carrier substance comprises a chemical compound which has such a low electron affinity that electrons are not bonded to a cluster fragment.

19. A use of a method according to one of the preceding claims:
- for absorbing surface adsorbates from a surface which are to be subjected to an analysis,
- for absorbing impurities from solid body surfaces for their purification, or

- for producing charged cluster fragments from clusters and aerosols which are to be subjected to charge measurement or mass spectrometry analysis.

20. A method for operating an ion thruster, wherein the charged particles for implementing the thruster thrust are formed by cluster fragments which are produced with a method according to one of the claims 1 to 16.

21. A cluster beam system, which comprises:
    - a cluster production device (60, 61),
    - a cluster fragmentation device (62), and
    - a measurement device and/or a manipulation device (64) for cluster fragments.

22. The cluster beam system according to claim 21, wherein the measurement device (64) is a mass spectrometer.

23. The cluster beam system according to claim 21 or 22, wherein the measurement device (64) is a charge measurement device.

24. The cluster beam system according to claims 21 to 23, wherein the manipulation unit (64) includes an electrode and/or device unit for producing temporally constant or temporally changing electromagnetic fields.

25. The cluster beam system according to one of the claims 21 to 24, wherein a beam limiter (63) is provided between the cluster production device (60, 61) and the cluster fragmentation device (62) in order to shape the beam according to a predetermined pattern.

26. The cluster beam system according to one of the claims 21 to 25, wherein at least one reaction partner supply device is provided.

27. The cluster beam system according to claim 26, wherein the reaction partner supply device is formed by an evaporation furnace.

28. The cluster beam system according to one of the claims 21 to 27, wherein a device for setting the electrical potential of the cluster fragmentation device (62) is provided.

29. An ion thruster (7), which comprises:
- a cluster production device (70, 71),
- a cluster fragmentation device (72, 73),
- control and steering devices (74, 75), and
- an acceleration device (76, 77).

CLAIMS

(as amended during PCT Chapter II procedure)

1. A method for self-ionizing cluster fragmentation comprising the steps:
   - production of at least one neutral cluster which contains a carrier substance, and
   - fragmentation of the cluster into positively and negatively charged cluster fragments,

   characterized in that

   the at least one neutral cluster is loaded before the fragmentation with at least one reaction partner, which is chemically different from the carrier substance and forms a pair of electrically differently charged charge carriers with the carrier substance in the cluster, spontaneously or excited from the outside, two electrically differently charged cluster fragments are formed during the fragmentation and the at least one reaction partner is part of at least one cluster fragment after the fragmentation, and the cluster fragments are permanently spatially separated.

2. The method according to claim 1, wherein the cluster is additionally loaded with an electrically neutral molecule.

3. The method according to claim 2, wherein, for manipulation of the neutral molecules, they are applied as an adsorbate coating to a solid body surface and are transferred from the solid body surface into a charged cluster fragment.

4. The method according to one of the preceding claims, wherein the cluster fragmentation occurs through collision of the cluster with a moving or static boundary surface or through direct energy input.

5. The method according to claim 4, wherein the boundary surface is a gas phase/liquid or gas phase/solid body boundary surface.

6. The method according to claim 5, wherein the boundary surface is formed by a solid body surface made of a metal, a semiconductor, or a dielectric.

7. The method according to claim 5, wherein the boundary surface is coated with reaction partner adsorbates with a surface density whose temporal average has a predetermined value.

8. The method according to one of the preceding claims, wherein the loading with the reaction partner occurs during the cluster production, during the cluster movement toward the boundary surface by interaction with at least one gas phase particle of the reaction partner, and/or during the collision with the boundary surface by absorption of reaction partner adsorbates into the cluster.

9. The method according to one of the preceding claims, wherein polar molecules or molecule groups are used as the carrier substance.

10. The method according to one of the preceding claims, wherein an electron transfer occurs between the carrier material (cluster) and the reaction partner, with molecules or atoms having low ionization energies, particularly alkali atoms, being preferred.

11. The method according to one of the preceding claims, wherein a proton transfer occurs between the carrier material and the reaction partner, with a strong acid being preferred as the reaction partner and a strong

base being preferred as the carrier material (cluster), and the reverse.

12. The method according to one of the preceding claims, wherein multiple clusters to be fragmented are produced by ultrasound expansion of a gas and/or a gas mixture by means of a nozzle arrangement.

13. The method according to claim 12, wherein the clusters produced are subjected to geometric beam limiting for irradiating the boundary surface according to a predetermined pattern.

14. The method according to one of the preceding claims, wherein the kinetic energy of the charged clusters is influenced by electrical and/or magnetic fields and the cluster fragments are subjected to a further fragmentation.

15. The method according to one of the preceding claims, wherein the cluster fragments are subjected to a count, a mass spectroscopy examination, or a material analysis.

16. The method according to one of the preceding claims, wherein the fragmentation of the cluster occurs by glancing incidence of the cluster on a boundary surface.

17. The method according to one of the preceding claims, wherein the carrier substance comprises a chemical compound which has such a low electron affinity that electrons are not stably bonded to a cluster fragment.

18. A use of a method according to one of the preceding claims:

- for absorbing surface adsorbates from a surface which are to be subjected to an analysis,
- for absorbing impurities from solid body surfaces for their purification, or
- for producing charged cluster fragments from clusters and aerosols which are to be subjected to a charge measurement or mass spectrometry analysis.

19. A method for operating an ion thruster, wherein the charged particles for implementing the thruster thrust are formed by cluster fragments which are produced according to a method according to one of the claims 1 to 16.

20. An ion source (7), which comprises:
- a cluster production device (70, 71), which is set up for producing multiple neutral clusters and controlling the cluster size,
- a cluster fragmentation device (72, 73), which is set up for loading the neutral clusters with at least one reaction partner and for fragmenting the loaded clusters into spatially separated cluster fragments with differing electrical charges, and
- an acceleration device (76, 77) for accelerating the cluster fragments.

21. The ion source according to claim 20 for use as an ion thruster, wherein the control and steering devices (74, 75) are set up for the purpose of steering positively and negatively charged cluster fragments in different directions, and the acceleration device (76, 77) is set up for polarity-dependent acceleration of the cluster fragments, so that the positive and negative cluster fragments are used for thrust production.